Space Weather Forecast

Issued on Wednesday, 28 December 2022 at 01:10 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Risk of Minor Geomagnetic Storms throughout, peak chance Friday 30 December. Chance of Moderate-class X-ray flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been moderate through the UTC day of Tuesday 27 December, with X-ray flares showing an uptick in magnitude relative to the Christmas period, with occasional Moderate-class activity developing. Two of these flares arose from a sunspot on the northeastern part of the Sun, with this spot being the most dynamic in the 24 hours - growing in size and number of constituent spots, as well as spreading longitudinally. A third moderate-class flare was observed from the long-term largest spot group on the Sun - in the northwest.

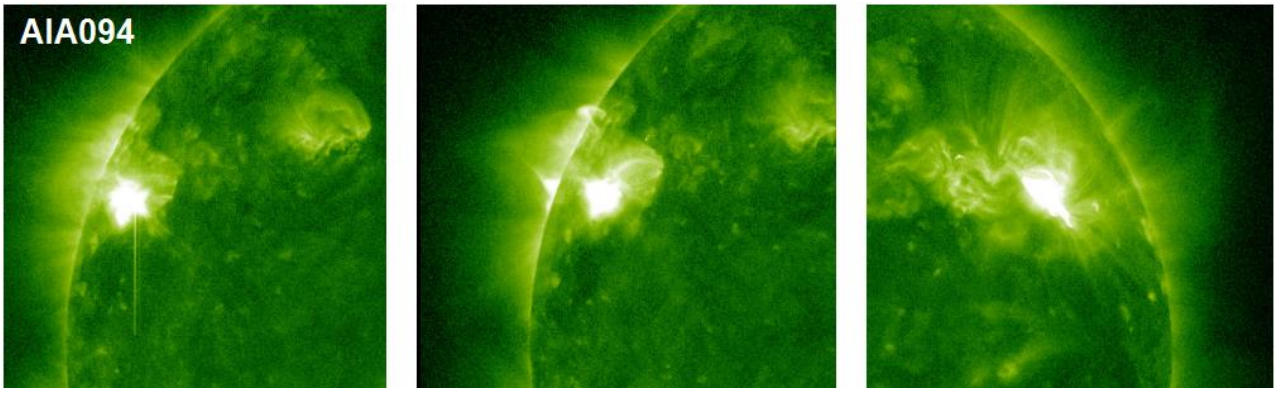

Figure 1: False-colour extreme UV imagery of the three Moderate-class X-ray flares observed in the last 24 hours.

The above sunspot regions were two of five on the facing side, although there are tentative signs of a new arrival on the southeastern solar horizon, with exact detail here to be determined. The largest group on the Sun in the northwest, showed a spreading trend that saw its span surpass 20 degrees solar longitude, although there were some signs of decay in its intermediate portion. The remaining groups on the facing side were all smaller and magnetically simpler, with slow decaying or stable trends.

Regarding potential sources of Coronal Mass Ejections (CMEs) in the period, most potential activity was based on both solar horizons, with a late 'prominence eruption' (at 27/2100UTC - being an arc of plasma ejected from the side of the Sun). This was observed departing the southeast near the assumed location of an arriving spot group. A later event was then seen at 27/2200UTC from the western solar horizon. No Earth-directed CMEs were detected in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds were suggestive of possible CME

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influence overlying a fast wind regime. The assumed sources are the tail end of the (emitted date/time) 24/0230UTC CME, with possible contribution later in the period from the 24/0800UTC CME, although the latter is more conjectural. Measurement of the solar wind parameters remains relatively noisy, with less precision possible than would normally be the case.

The solar wind speed has been Elevated in the past 24 hours on a relatively flat trend. The number of particles measured in the solar wind was especially erratic, owing to differences in character between the two main measuring satellites, however appears to have remained largely on a stable tendency near long-term background throughout. The magnetic field associated with these particles showed a smooth sinusoidal trend, peaking at Slightly Elevated levels during the UTC morning of 27 December before tailing off as the period drew to a close. The north-south component was also smooth, but almost entirely anti-aligned with Earth's field until 27/1630UTC. Upon resumption of a more variable character, geomagnetic indices peaked, with a 62.0nT deflection in Hartland BGS Magnetometer at 27/1618UTC. It is not impossible that there was some additional input from the awaited 24/0800UTC CME, but this is perhaps an outside chance given the lack of obvious diagnostic sharp discontinuities at the measuring satellites.

The net effect of the above solar wind measures was for provisional Minor Geomagnetic Storm G1 intervals in the 15-18UTC interval, and revised upwards after-the-fact for the 03-06 and 06-09UTC intervals.

Energetic Particles / Solar Radiation: No solar radiation storms were observed, despite the increase in magnitude of potential generative X-ray flare events.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily chance of Moderate-class X-ray activity, with the main contributions from the long-term largest group, a sunspot in the northeast, and perhaps now also an arriving southeastern spot group. The largest group is expected to depart the Earth-facing side through the course of day three, Friday 30 December, with the chances of R1 correspondingly falling slightly given the uncertain contribution from any eastern solar horizon arrivals at present.

Solar Wind / Geomagnetic Activity: There are up to two fast wind enhancements due in the period, firstly the currently observed fast regime, but then a second resurgence due before the UTC weekend. Overlying this is a possible glance from a CME that left the Sun on 25 December, which should pass Earth's orbital radius on 29 December, albeit with low confidence. A CME from 24/0800UTC was due on 27 December. There are three possibilities as regards this feature: firstly it has now already passed nearby to little effect; secondly it contributed to geomagnetic activity on 27 December; else thirdly it remains outstanding but should have its impacts reduced for being late in arriving (i.e. slower and less impactful). No new CMEs were observed in the past 24 hours.

All considered, there is a slight chance of G1 on all days, rising to a peak chance on Friday 30 December as a result of the relatively more reliable onset of the fast wind (versus glancing CME arrivals).

Energetic Particles / Solar Radiation: No solar radiation storms are expected, however there is a daily slight chance given the number of large sunspots on the disc and the increased tendency towards moderate-class X-ray flares.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	10	20	40	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	40	40	40	30
Very Active	R3 to R5 X	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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